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Chairside treatment of amelogenesis imperfecta including establishment of a new vertical dimension using resin nanoceramic and intraoral scanning

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ABSTRACT

Amelogenesis imperfecta represents a hereditary disease affecting the structural development of tooth substance. This clinical report describes a 1-visit chairside treatment of an 8-year-old patient with amelogenesis imperfecta using computer-aided design and computer-aided manufacturing technology (CAD/CAM). Intraoral scanning was performed with the CEREC Omnicam. Thirteen resin nanoceramic crowns (Lava Ultimate) were fabricated chairside with the CEREC MCXL milling unit and seated adhesively. The patient's treatment included establishing a new occlusal vertical dimension and new centric relation. Reevaluation after 6 months showed a stable situation.

INTRODUCTION

The treatment of patients with severe amelogenesis imperfecta often represents a challenge as the mechanical properties of the dental tissues are often poor.¹ Because of the brittle tooth substance, vertical dimension is often lost, resulting in various functional problems such as temporomandibular disorders.² Therefore, a complete mouth rehabilitation at an early age seems to be an appropriate approach. Many treatment options have been proposed for amelogenesis

imperfecta.³ Conservative approaches with direct composite resins or more extensive complete crowns have been the most commonly described treatment options.^{4,5} One of the shortcomings of both of these treatment options is the need for multiple dental visits and the substantial chair time required. The recently published literature outlines the benefits of early treatment of amelogenesis imperfecta.⁶ Early intervention is reported to be beneficial for the patient as it minimizes tooth decay and wear and thus stabilizes the vertical dimension.⁷ However, early treatment for young patients has often been limited to the use of interim materials such as stainless steel crowns.⁸

CLINICAL REPORT

The patient and parents first attended the Department of Restorative Dentistry and Periodontology at the Ludwig-Maximilians-University when the patient was 8 years old. Their wish was for complete mouth rehabilitation, as the patient suffered from severe hypersensitivity. A comprehensive evaluation including radiographs was performed. No functional disorders were noted. The diagnosis was a severe form of amelogenesis imperfecta type II. Complete-arch scans of the intraoral situation were made using a powder-free intraoral scanning device (CEREC AC Omnicam; Sirona) (Fig. 1). Conventional impressions were made (Alginat; Omnident Dental) and diagnostic casts poured with Type IV gypsum (CEREC Stone BC; Sirona). After discussing treatment options with the patient, the treatment plan was as follows: complete crowns for the primary premolars and permanent molars providing an increase of 5 mm in the vertical dimension. The measure of vertical increase was set in respect to the presumable loss of tooth substance both for functional and esthetic aspects. As no functional disorders were found, there was no need for preliminary splint therapy. The clinical treatment was performed in a 1-visit chairside treatment using computer-aided design and computer-aided manufacturing technology

(CAD/CAM), with the patient under general anesthesia.

The diagnostic casts were mounted on an articulator with an increase of 5 mm in the vertical dimension. Both maxillary and mandibular permanent molars and primary premolars were waxed to the new vertical dimension. An occlusal device, from canine to canine, was fabricated using silicone material (Optosil Comfort Putty; Heraeus Kulzer). Complete-arch scans of the waxed maxillary and mandibular arch were made with the CEREC Omnicam (Fig. 2). The CAD design mode for CAD/CAM restorations was set to 'biocopy' mode.

The patient underwent general anesthesia and was supervised by anesthesiologists throughout the procedure. Local anesthesia (Ultracain D-S 2%; Sanofi Aventis) was also administered. The teeth were prepared according to guidelines.⁹ An astringent paste (Astringent Retraction Paste; 3M ESPE) was used for hemorrhage control. Quadrant scans of the maxillary and mandibular arch were made (Q1/Q4 and Q2/Q3). Then, a buccal scan in the premolar region was made with the silicone device inserted in the anterior tooth region. The CAD design was performed using virtual articulation and 'biocopy' mode (CEREC software v4.2.). Resin-based CAD/CAM nanoceramic blocks were selected as restorative material (Lava Ultimate; 3M ESPE) (shade A3.5 LT) and milled with the CEREC MCXL milling unit (cylinder pointed bur 12, step bur 12s). The milling mode was set to 'standard'. Composite resin restorations were provided for both central and lateral maxillary incisors (Tetric Evo Ceram; Ivoclar Vivadent AG) using a standardized protocol (Syntac; Ivoclar Vivadent AG). The CAD/CAM restorations were seated adhesively. The luting surfaces of the restorations were airborne-particle abraded with Si-coated aluminum oxide (Cojet; 3M ESPE)(diameter $\leq 50 \mu\text{m}$, 200 kPa). The restorations were cleaned with alcohol and air dried with oil- and water-free air. Before luting, silane (Espe-Sil; 3M ESPE) was applied to the luting surface of the restorations for a period of at least 60 seconds. The

prepared teeth were isolated with a rubber dam and etched with 37% phosphoric acid (30 seconds enamel, 15 seconds dentin). Syntac was used as an adhesive bonding agent (15 seconds primer, 10 seconds adhesive, Heliobond) with Variolink II high viscosity (Ivoclar Vivadent AG) dual-polymerizing composite resin system. After removing any excess, an oxygen layer inhibitor material was applied to the area of the cementation interface (Airblock; Dentsply DeTrey). Luting composite resin was polymerized with a polymerization lamp (Satelec MiniLED; KaVo) using 16 J/cm^2 from the occlusal, mesial, distal, buccal, and lingual aspects for 60 seconds each. The restorations margins were finished and the occlusal contacts were adjusted using fine diamond rotary instruments coupled with constant water-cooling. A 3-step ceramic polishing kit (Brasseler) was used for the definitive polishing procedure. The clinical treatment procedure for tooth preparation and transfer of the vertical dimension from the articulator to patient is shown in Figure 3. The CEREC procedure for the transfer of the waxing to the CAD/CAM restorations is shown in Figure 4. In Figure 5, a comparison between the preoperative and postoperative situation is shown.

DISCUSSION

This clinical report describes a complex 1-visit chairside treatment of an 8-year-old patient with amelogenesis imperfecta using computer-aided design and computer-aided manufacturing technology (CAD/CAM). Only laboratory CAD/CAM procedures have been described in the literature for the treatment of amelogenesis imperfecta in the past.¹⁰

The treatment need for primary teeth is controversial. The most severe problems for patients living with amelogenesis imperfecta occur if the initial vertical dimension is lost.¹¹ Consequently, the early treatment of amelogenesis imperfecta might minimize the extent of caries and tooth wear. The early treatment may therefore prevent functional disorders from

appearing.^{6,7} Simultaneously, the space required for permanent tooth eruption can be ensured. This means that complex orthodontic treatment may be prevented for some patients.¹² Compared with the conventional multivisit treatment approaches, the 1-visit chairside CAD/CAM approach described is advantageous as additional appointments are no longer necessary for the replacement of poorly-fitting stainless steel crowns on permanent molars.⁸

Compound CAD/CAM materials such as resin-based nanoceramic might be preferable for chairside treatments because of their fast postprocessing protocol. Furthermore, several studies have demonstrated their advantages.¹³

However, the CAD process ‘biocopy’ described in this report has proven difficult. As large identical areas of tooth surface are required for the superimposition of 2 different digital scans, matching could be achieved only after a few minutes, perhaps because brittle tooth substance resulted in a slight loss of tooth material between the waxed model scan and intraoral preparation scan.

The rapid development of CAD/CAM technology may make the future treatment of complex cases of amelogenesis imperfecta, such as this one, easier to treat. Significant improvements regarding the CAD process have already been integrated into new CAD/CAM systems such as virtual articulation and jig function.¹⁴

SUMMARY

This clinical report describes the 1-visit chairside treatment of an 8-year-old patient with amelogenesis imperfecta using computer-aided design and computer-aided manufacturing technology (CAD/CAM). The patient’s treatment included the establishment of a new occlusal vertical dimension.

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FIGURES

Fig. 1. CEREC Omnicam intraoral complete arch scan before clinical treatment: mixed dentition, multiple caries lesions, general loss of enamel, aplasia of permanent mandibular left second premolar. A, Maxillary and mandibular arch. B, Preoperative vertical dimension.

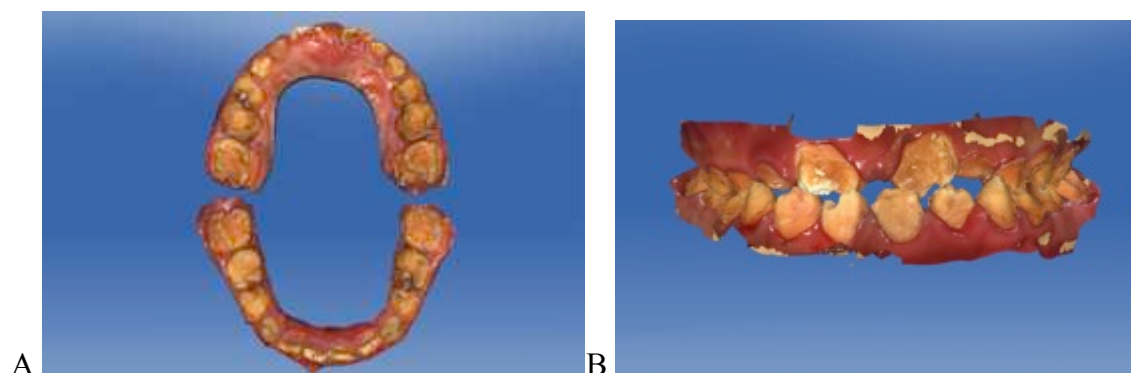


Fig. 2. CEREC Omnicam complete-arch scan of model waxing: waxed restorations for permanent molars and primary premolars with increased vertical dimension. A, Maxillary and mandibular arch. B, Planned new vertical dimension.

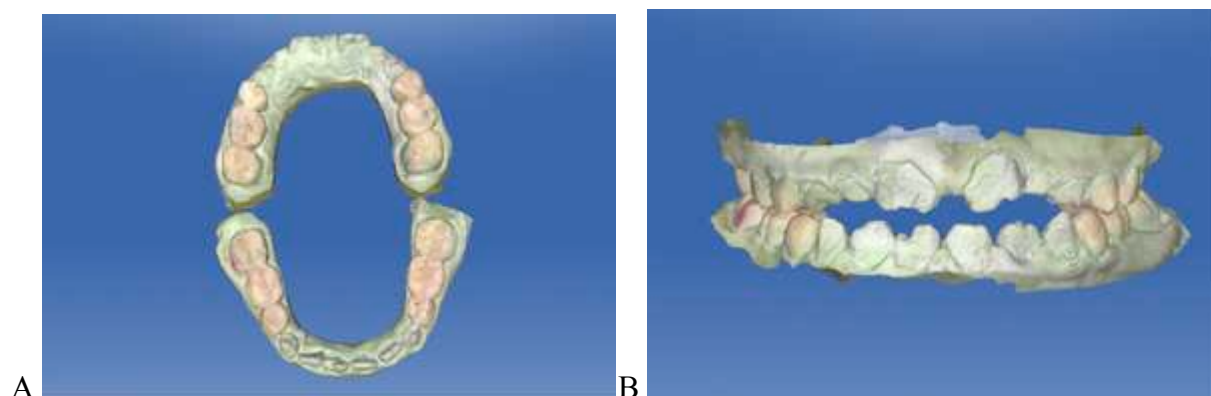


Fig. 3. Example of step-by-step clinical procedure for maxillary left and mandibular left quadrant. A, Initial situation primary first and second premolar and permanent first molar. B, Defect orientated preparation of teeth for complete crown restorations. C, Hemorrhage control using displacement paste. D, Transfer of new vertical dimension to oral situation using silicone splint.

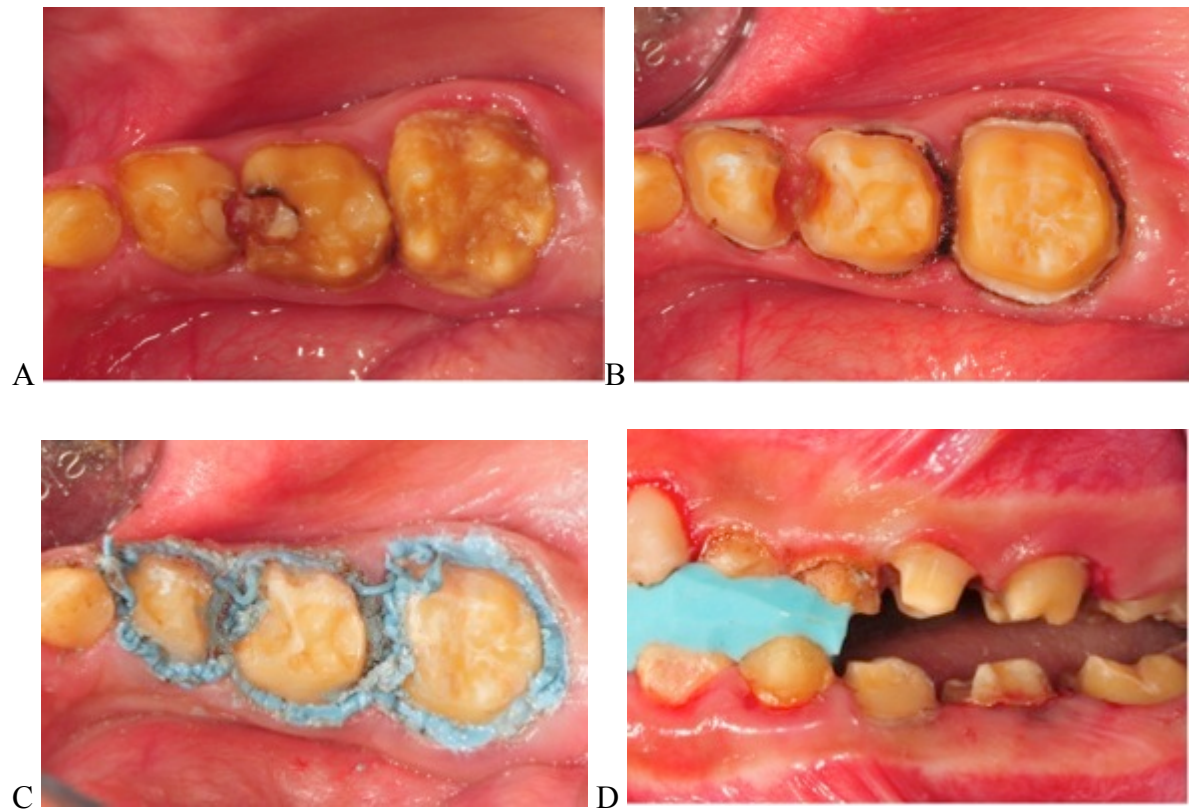
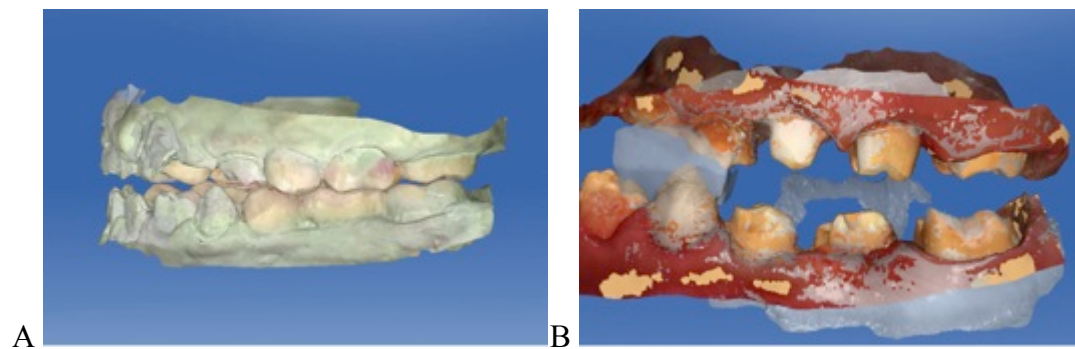


Fig. 4. CEREC CAD/CAM procedure step-by-step for maxillary left and mandibular left quadrant. A, Preoperative waxing at 5 mm increased vertical dimension. B, Tooth preparation and buccal registration with splint in region of canines. C, Chairside CAD Design of Lava Ultimate CAD/CAM crowns. D, Definitive design of Lava Ultimate complete crowns.



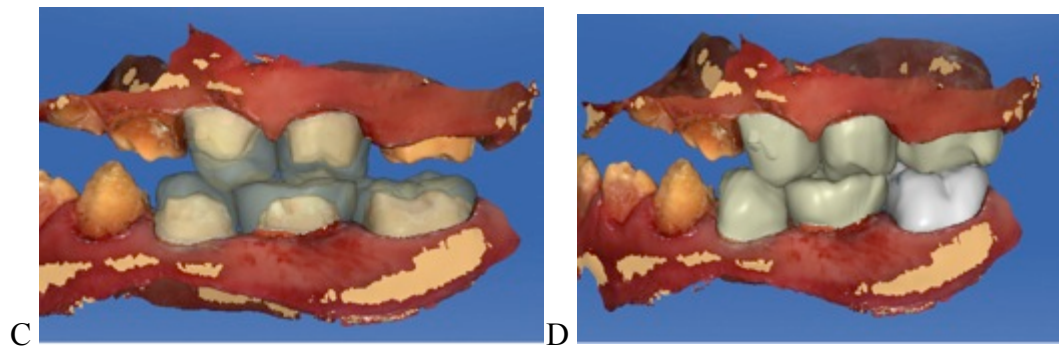


Fig. 5. A, Preoperative facial view. B, Postoperative facial view.

